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LIFE HISTORY OF *VANDUZEA ARQUATA* SAY (MEMBRACIDÆ).[1]

By W. D. Funkhouser.

Although *Vanduzea arquata* Say is one of the most widely distributed of the species of Membracidæ in the United States, its life history has not hitherto been described. The species is very abundant in the vicinity of Ithaca, N. Y., on locust (*Robinia pseudacacia* L.) and the following study has been made during the summers of the past five years, the data being compiled largely from field notes made during that time. For three years almost daily notes were made of the life history of this Membracid including date, locality, host, weather and temperature records, and the insects were observed under natural conditions. Specimens were reared in the insectary merely to ascertain the lengths of the various instars, and these laboratory records have been used only as a check upon the field notes. *Vanduzea arquata* is by far the most common Membracid in the Cayuga Lake basin and no difficulty has been experienced in securing both adults and nymphs throughout the season.

I am indebted to Professor O. A. Johannsen of the Entomological Department of Cornell University for his very helpful suggestions and criticisms in the course of this study, and to Professor W. M. Wheeler of the Bussey Institution, Harvard University, for the determination of the ants which are attendant on this species of Membracid.

Historical.

This insect was described by Say as *Membracis arquata* in 1831 (Journ. Acad. Nat. Sci. VI: 302. 12). Fitch recorded it as

[1]Contribution from the Entomological Laboratory of Cornell University.

a *Carynota* in 1851 (Cat. Hom. N. Y., 48. 651) and Walker in the same year (List Hom. B. M., 144. 2) also placed it in this genus. Van Duzee mentioned it as *Ophiderma arquata* in 1890 (PSYCHE V: 389) in which genus it remained until Goding made it the type of his new genus *Vanduzea* in 1894 (Catalogue of Described Membracidæ of North America, 440. 136). The species has been often mentioned in literature and Matausch has published an excellent figure of the last instar in his paper on the last nymphal stages of Membracidæ in 1912 (Bull. Amer. Mus. Nat. Hist. XXXI: Pl. 32, Fig. 16). Van Duzee gives its principal range as from Ohio southward (Bull. Buffalo Soc. Nat. Sci. IX: 103) but it has also been recorded from most parts of the United States east of the Rocky Mountains.

General Description.

Vanduzea arquata is one of the smaller of the species of Membracidæ represented in the local fauna. The sexes are quite distinct in size and color, the females being light chocolate-brown with yellowish white fascia and nearly six millimeters long while the males are very dark brown with less extended fascia and much smaller than the females. The dorsum in the males, also, is inclined to be depressed behind the middle, while that of the females is nearly straight in this region. The species may be at once recognized by the straight, transverse base of the terminal cell of the fore-wing, the transversely rounded dorsum, the pubescent pronotum with the characteristic markings (Figs. 9 and 10) and the punctured costal area of the fore-wing.

Habits.

Two species of Membracidæ, *Thelia bimaculata* Fab., and *Vanduzea arquata* Say. are commonly found upon the locust in central New York, and of these the latter is more abundant, although less conspicuous, than the former. Locally they may be found in surprising numbers throughout the entire summer, being so numerous, in fact, that it is not unusual to take several hundred individuals from one host plant in a single hour's collecting. The adults and nymphs are found crowded in the notches of the twigs, usually in the irregular crevices left by the old bud-scales of the preceding year, and may be easily located by the

swarms of attending ants which are always to be noticed where the membracids are congregated. The adults seem to be decidedly gregarious and are seldom found alone. From twenty to thirty may be seen closely arranged around the base of a twig, their bodies touching, their heads pointing towards the base of the branch, and often the nymphs concealed in the crevices of the bark below them. Here they rest by the hour, motionless, without change of position, and apparently not even feeding. Unlike most of the local forms of the family, they prefer the upper, rather than the lower sides of the branches, and the adults are very seldom found on the leaves and never on the trunk. They enjoy the sun and are most numerous on the south sides of the trees; they are rarely found in shady places, as the open groves, roadsides, and scattered trees furnish the most favored habitats. Both young and old trees harbor them, but they always choose the lower branches, well out towards the ends. Whether this characteristic location is chosen to favor the attendance of the ants would be a matter of conjecture; certainly they seem in no way averse to this symbiosis.

This Membracid is comparatively active, leaving the branch with a quick "snap" when disturbed and disappearing with a flight too rapid to be followed by the eye. If care is taken, however, they may be secured in the fingers, and after a little practice this proves to be the most satisfactory method of collecting, since they fly well and will not drop to the ground when the limb is beaten, and the thorny host does not lend itself to the use of a net. As in *Thelia bimaculata*, the migration of this species is slow, one tree often being loaded with individuals while another in close proximity is barren. If disturbed, the insects usually return to the same tree from which they were frightened.

Adults first appear in this locality about the first week in June. The earliest record is May 29, 1912, when three females and two males were taken. From this date they are common until late in October, depending on the weather conditions. They have always been found after the first heavy frost [1] and are sometimes persisting and surprisingly active after the first few snows. In

[1] On September 28, 1913, after a very heavy frost in the Cayuga Lake region, thousands of these insects were found on the hills east of the lake. The individuals were sluggish, but several days later, after some warmer weather, seemed as active as in midsummer.

the latter part of the season the males are more numerous than the females—counts made in late September 1911 showed an average of five to one—and this condition has been regularly observed each year. It is of interest to note that the opposite is true of *Thelia bimaculata*, the other species inhabitating the locust, in which species the males become scarcer in August and have practically disappeared by the first of October, although the females persist as do the males of *Vanduzea arquata*. There is no evidence to show that adults survive during the winter. Careful examination has failed to show any trace of their hibernation and no adults have been observed in the spring previous to the development of the nymphs.

Nymphs appear locally about the first of May, the earliest field record of their presence being April 26, 1914. They are usually found flattened in the crotch of a twig or axil of a leaf, generally just above the egg-mass from which they hatched. The most usual position shows the head pointing toward the angle in the stem and the body tightly compressed into a crevice in the bark. Their protective resemblance while in this position is excellent and were it not for the attendant ants, the presence of the early stages of the nymphs would escape any but the most careful search. Like most Membracid nymphs which give off an anal liquid, this liquid is excreted when the nymph is picked up or disturbed. The immature forms are very sluggish and merely hold fast to the irregularities of the bark when an attempt is made to remove them. They seldom move more than a few inches from the egg-slit until the last instar, at which time they crawl out to the under-side of a leaflet for the last molt.

Nymphs have been collected in the first and second instars late in October, and it is probable that many of the last brood fail to reach maturity in years in which there is early frost or premature cold weather.

Mating and Oviposition.

Mating begins in the field during the middle of June. The earliest recorded date is June 12, 1911. The pair is usually found in the mass of individuals in the angles of the branches. They seem quite restless at this time and are easily disturbed. When molested they fall to the ground, not, however, becoming detached

from each other. Copulation has been timed for ten minutes, but may average longer. Mating has not been observed generally throughout the summer, but after the period in June the process seems to be discontinued, to become very noticeable again about the middle of August.

There appear to be three rather distinct seasons for egg-laying, one about the middle of June, one the last of July, and one in September; during the summer the eggs are laid at the base of the bud scales of the preceding year, in the fall the eggs are laid in the buds. These periods, however, are more or less irregular, and the nymphs do not all mature at equal rate, so that immature forms of all stages may be found during most of the summer. The eggs laid during the early summer failed to hatch in the laboratory, probably on account of the unnatural sap conditions to which the twig was necessarily subjected, so that it could not be definitely ascertained in the course of this study just what the exact time was which was required for hatching. Field notes, however, record eggs laid on July 15 and the first instars observed on July 29, so that the time is approximately fourteen days. The eggs laid in the fall winter over, and when twigs containing these eggs are brought into the laboratory in the spring, the nymphs emerge shortly after the opening of the bud.

In oviposition the female makes a small, deep puncture and apparently does not remove the ovipositor during the process, although a decided movement of the abdomen may be observed. From three to six eggs are laid in one mass, in a finger-like cluster (Fig. 2), the bases of the eggs being about .3 mm. apart and the tips pressed closely together. The average number of eggs in such a cluster is four. The slit is very small—about 1.5 mm. long—and soon closes after the ovipositor is withdrawn, leaving no external evidence of the process. The eggs are about 1.4 mm. long, white, and club-shaped (Fig. 1), quite large for the size of the insect. The inner surface of the outer bud scales of the locust is covered with a deep, felt-like pile of soft hair which covers and protects the eggs (Fig. 3.) The eggs are laid deep at the base of the scale and the tips do not project out of the host, as in the case of the eggs of some of the other members of this family.[1] One female has been observed to make two such slits,

[1] Cf. Hodgkiss, H. E. The Apple and Pear Membracids. Agr. Exp. Sta. Tech. Bull. 17. Geneva 1910. Pl. 3, Fig. 1.

and sometimes three females have been seen ovipositing at the base of one stem. The large number of individuals of this species which appears every year is probably not due to the large number of eggs laid by one female, but to the large number of egg-masses from different females laid in one host. It is not known how many eggs may be laid by one individual, since it has not been found practicable to keep large pieces of the host plant in the laboratory for any considerable length of time.

Emergence and Development of Nymphs.

Although the first nymphs do not begin to appear in this locality until early in May, they may be forced in the laboratory earlier than this. The eggs break open widely at the tips but the nymphs sometimes delay emergence for several days after the eggs have begun to open.

Five instars are passed in the process of development. The first is characterized by the long, fine, hair-like bristles which extend in three rows down both sides of both the thorax and the abdomen, and by the white band down the median dorsal line of the body (Fig. 4). In the second instar (Fig. 5) the lateral bristles have disappeared and the entire body is hairy while the dorsal bristles are simple and long on both thorax and abdomen. The third instar (Fig. 6) shows no dorsal bristles on the thorax and the abdominal bristles are heavy and branched; the pronotum has begun to extend itself posteriorly and the lateral margins of the meso- and metathorax are beginning to form the rudimentary wing-pads. In the fourth instar (Fig. 7) the pronotum covers the dorsal part of the mesonotum and the wing-pads are well developed, reaching to the second segment of the abdomen. The fifth and last instar (Fig. 8) presents a greatly developed pronotum which now covers both the mesonotum and the metanotum, and the wing-pads are fully formed, reaching to the third abdominal segment. Thus each instar may be recognized by rather clearly defined characters of the thorax and abdomen.

The time occupied in this process is subject to considerable variation and all of the nymphs from one egg-mass do not reach maturity at the same time, there being sometimes a difference of as much as two weeks between the maturing of the earliest and latest individuals. An average laboratory record shows the

following data for one individual: first instar, 5 days; second, 3 days; third, 3 days; fourth, 4 days; fifth, 6 days; total, 21 days. Much difficulty was experienced in recording the second and third molts which were very erratic and often, for some reason, the second molt could not be discovered at all, the nymphs appearing to pass over this molt entirely. Although 21 days is thus given as the average, the period from egg to adult has been known to last for 33 days, and in the most rapid growth observed, occupied 18 days. A twig in the field, harboring nymphs of the first instar, was enclosed in netting on July 30, 1913, and the first adults appeared from this brood on August 16, making a total of 17 days. Presuming that the nymphs were two or three days old when first found, which was very likely the case, this field record conforms very well with the average. The averages of a considerable number of observations gives the following summary as perhaps the normal:

	Days
First instar	5– 8
Second instar	3– 5
Third instar	3– 5
Fourth instar	3– 6
Fifth instar	5–10
Total	19–34

Ecdysis.

The first splitting of the integument appears down the median line of the thorax, and not on the dorsal part of the head as in most cases which have been observed in the Membracidæ. The skin over the head opens next and then that on the dorsal line of the abdomen, the latter splitting for practically its whole length. In the last molt the insect usually creeps out to the under side of a leaflet and fastens itself securely by the first two pairs of legs. The last pair of legs is left free and used to a slight extent in the process. The dorsal part of the thorax emerges first, quickly followed by the head; the legs are then withdrawn rather slowly and the abdomen pulled out more or less sidewise as the insect seeks a new foothold beside the old skin. The time consumed in this process is from five to twelve minutes. The exuviæ are usually perfect and may be found hanging to the underside of the

leaflet for many days after ecdysis. These old skins are particularly abundant locally during the middle of August.

The newly emerged adults are soft-bodied and yellowish in appearance and the normal color is not entirely evident nor the pronotum completely hardened for more than twelve hours after emergence. The insects fly in ten minutes after the last molt.

Broods.

On account of the overlapping of the stages of nymphal development and the consequent prolongation of mating periods after maturity, no definite number of days can be assigned to the period from oviposition to the adult stage. The failure to rear individuals from the eggs laid during the summer, also, has made it impossible to determine the exact period of incubation for these eggs, and the estimation of the number of broods can be based only on observations in the field. Since, however, the first adults which have hatched from the winter eggs do not appear until about the first of June and the first nymphs from this generation are to be found about the first of July, it would appear that the time required for mating, oviposition, incubation and hatching is approximately one month. As these nymphs require about twenty days for development, the total period between generations of adults would be nearly six weeks. Under favorable seasonable conditions, then, it may be estimated that there are three broods during the summer and one from the winter eggs, making four broods per year. Thus the greatest number of adults would be expected in early June, the middle of July, the last of August and the middle of October, and the greatest number of nymphs in early May, the middle of June, the last of July and the middle of September. Field observations bear out this theory very well, although, as has been stated, the variations in periods of development make it possible to find nymphs of practically all stages throughout the summer.

Feeding.

The beak of the Membracid is well fitted for piercing, being strong and heavy, and fitted with bristle-like mandibular and maxillary setæ. Both nymphs and adults have little difficulty in forcing the beak almost as far as the clypeus into the young stems

and the petioles of the leaves, the parts of the plants on which they most commonly feed. Feeding may be observed at almost any hour during the day but the most favored time appears to be the middle of the afternoon. The fact that their bird enemies are not usually present during the heat of the day might be advanced as a reason for the activity of the insects at this time. The Membracids do not, however, display any great energy in their feeding movements. They remain in one spot for a long time, seeming to find an inexhaustible supply of sap at each insertion of the mouthparts, and they show little disposition to seek new feeding places. So deeply and firmly is the beak buried in the tissue of the host, and so absorbed do the insects appear to be while obtaining food, that often, in collecting, the mouthparts are broken off and left in the stem when the specimen is captured.

Ecology.

Environmental conditions undoubtedly play an important part in the life history of this insect, and it seems very likely that when sufficient experimental data is available it will be found that many of the seeming irregularities in the periods of development which have been noted, may be explained by the variation in temperature and moisture to which the eggs and nymphs are subjected. While no definite facts have been secured experimentally in the course of this study on the relation of this insect to its environment, several suggestive features have been noted which bear on this phase of the subject.

The summer of 1913 was the occasion of the worst drought which has been experienced in this locality for many years. Vegetation suffered greatly and the Weather Bureau reported that all recent records were broken for lack of rainfall at the Ithaca station. It was during this summer that the field records showed the most variation in the appearance of the broods of *Vanduzea arquata*. The early spring of 1914, on the other hand, was marked by unusual precipitation and during this spring the eggs hatched earlier than in former years. In the same manner it has been observed that the nymphs developed more rapidly when the days were warm than they did during weeks of cold and un-seasonable weather. As might be expected, also, early springs and

late winters have occasioned correspondingly early appearance and late persistence of the forms in the field.

Such conditions seem undoubtedly to affect the eggs and the nymphs, and may very logically be presumed to have an influence also on the mating, oviposition and general activities of the adults.

Hosts.

Robinia pseudacacia L. seems to be by far the most favored if not the only host in this locality. Specimens of *Vanduzea arquata* have been collected on willow, oak, elm and wild cherry in localities where there were no locusts in the immediate vicinity but as the Membracid under consideration flies well, its appearance on these trees may have been accidental. No evidences of eggs or nymphs have ever been found except on the locust, nor have specimens ever been collected in the grass or weeds or by sweeping, so that is seems evident that the entire life cycle of the insect is usually spent on this one host. Van Duzee gives the locust as the dominant host for Ohio and southward (Studies in North American Membracidæ, 103. 1).

It may be of interest to note that, although *Robinia viscosa* Vent. and *Gleditsia triacanthus* L. are well represented in the local flora, they are never found as habitats for these Membracids.

Enemies.

This species of Membracidæ seems to have few natural enemies. The eggs are not infrequently parasitized but the writer has not been able to rear the parasites and they have not been determined. The parasitism does not seem to extend to the nymphs or the adults and, although a large number of both have been dissected with a view to ascertaining this fact, no parasitic larvæ have been found. This is rather remarkable in view of the fact that the local forms of the genera *Telamona* and *Thelia* are commonly parasitized.

Birds feed on the nymphs but not to any great extent. A chipping sparrow has been watched industriously searching for the immature forms but neglecting the adults. The latter are probably sufficiently protected from bird enemies by the hard pronotum and sharp posterior process. A number of instances of

spiders capturing the Membracids have been recorded and the adults are occasionally found in spider webs, although in most cases the spiders have been seen to capture the Membracid on the twig and spin the web around the body until the insect was enclosed in a cocoon-like mass, after which it was carried away. In these instances the Membracids did not appear to have been bitten by the spider, at least not to the extent of paralysis, for the legs could be seen moving and the body struggling after the encasement in the web. Here, again, the hard pronotum probably proved a method of protection. One instance has been noted of an Asilid (*Erax bastardii* Macq.) carrying off an adult, and one instance, also, of a Mantis feeding on a nymph.

Attendance by Ants.

Both nymphs and adults are commonly attended by ants and this appears to always be the case where the Membracids are present in large numbers. The ants stroke their charges with their antennæ whereupon the Membracids give off from the anal tube a liquid that issues in bubbles in a considerable quantity. The anal tube of *Vanduzea arquata* is capable of great evagination, especially in the nymphs in which it is long, black and cylindrical and usually tipped with a fringe of fine hairs. The so-called "honey-dew" is eagerly taken from the end of this tube by the ants. In this species the adults as well as the nymphs are sought, and the ants seem to be as attentive to one as to the other, but the adults have not been observed to excrete the liquid to the same extent as the nymphs. The mutual relationship of the two insects offers a most interesting field for study and has been observed in other Membracidæ by a number of authors at various times. The more important references to the subject are by Baer, Belt, Buckton, Green, Lamborn, Miss Branch and Mrs. Rice.[1]

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[1]Baer, G. A. Note sur une Membracide myrmécophile. Ann. Soc. Ent. France, 1903. LXXII: Bull. 306.

Belt, T. Honey exuding Membracidæ attended by ants. Naturalist in Nicaragua. 1874.

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Green, E. E. Note on the attractive properties of certain larval Hemiptera. Ent. Month. Mag. Aug. 1900. XXXVII: 185 p.

Lamborn, W. A. Ants and Membracidæ. Trans. London Ent. Soc. 1913. 494–498 p.

Poulton, E. B. Suggestions as to the meaning of the shapes and colours of the Membracidæ. In Buckton's Monograph. 273–285 p.

Branch, Hazel E. Morphology and Biology of the Membracidæ of Kansas. Kansas University Bull. 1913. VIII: No. 3. 84 p.

Rice, Mrs. M. E. *Entylia sinuata.* Insect Life. 1893. V: No. 4. 243–245 p.

The species of ants which have been found locally attending *Vanduzea arquata* have been determined by Professor Wheeler as follows: *Formica obscuriventris* Mayr., *Formica exsectoides* Forel, *Camponotus pennsylvanicus* DeGeer, *Crematogaster lineolata* Say, *Prenolepis imparis* Say.

Economic Importance.

Although the immense number of insects, with their attendant feeding and oviposition, would naturally be supposed to affect the host, very little damage, as a matter of fact, seems to result from their existence on the locust. The amount of sap consumed would of course be practically negligible and the buds seem in no way retarded in their development by the presence of the eggs. The egg-slits are very small and heal very quickly, leaving no wound, and no trace has been found of fungus or of other insects in these incisions. A careful comparison of trees in the field fails to show that those harboring this species of Membracidæ are in any way less sturdy than those on which the insects are not found. These facts have led to the conclusion that the economic importance of the insect is hardly to be considered.

Technical Descriptions.

Egg.

Measurements: Length 1.4 mm.; maximum width .3 mm.

Smooth, without sculpturing; white; club-shaped; neck gradually acute, very slightly grooved; micropyle oval, opening tangential to longitudinal axis; base smooth, rounded; chorion white translucent; cap small, subcylindrical.

First Instar.

Measurements: Length 1.2 mm.; maximum width .25 mm.

Very light grayish-brown with top of head and line down median dorsum white; six longitudinal rows of long, white bristly hairs, two rows down dorsum and two rows on each side; abdomen upraised; entire body noticeably long in proportion to its width.

Head broad, gray-brown in front, white and produced above, covered with white bristly hairs, top of head bidentate; eyes reddish; ocelli not visible; antennæ scarcely visible; clypeus set off by distinct white suture. Thorax brown with broad, white, median dorsal band; segments distinct and subequal; each segment with a stiff, white bristly hair on each side dorsal line and two lateral bristles on each side, one below the other. Abdomen brown on lateral areas, white on dorsal line, under surface white; eight distinct segments each armed with a pair of long bristles above and two single bristles on each side; first abdominal segment short, eighth long, others equal in length; anal tube long, dark colored, evaginated; tip of abdomen

distinctly upraised. Legs uniform gray, very hairy; tarsi ferruginous. From a nymph killed and described immediately on its emergence from the egg.

During this instar the nymph increases in length about .6 mm., and gradually becomes darker in color.

Second Instar.

Measurements: Length 2–2.5 mm.; maximum width .5–.8 mm.

Dark brown, lighter on dorsum, top of head white; median dorsal line distinct, a row of bristles down each side of median dorsal line; abdomen broad, tip upraised; sides of thorax and abdomen hairy, hairs not in rows.

Head broad, dark brown except dorsal apex which is white; produced above, dorsal apex in two tubercles; very faintly pubescent; eyes reddish, borders white; ocelli small, white; antennæ very small; clypeus long, distinct; beak extending to a point half way between hind coxæ and tip of abdomen, mandibular and maxillary setæ capable of extension as far as tip of abdomen. Thorax brown, lighter above; each segment with one pair of strong dorsal bristles and many lateral hairs; prothorax longer than meso or metathorax and provided with a pair of strong hairs anterior to bristles; meso- and metathorax subequal. Abdomen reddish-brown, dorsal region lighter, underside red, last segment and anal tube very dark brown; each segment with a pair of dorsal bristles and many short, stiff, lateral hairs irregularly arranged; last segment twice as long as the one before it and bearing two pair of dorsal bristles. Legs mottled brown above, almost white below, not hairy; tibiæ with brown patches above; tarsi yellow-white; claws ferruginous.

Third Instar.

Measurements: Length 2.5–3.5 mm.; maximum width 1–1.3 mm.

Red-brown; frontal tubercles of head very small; pronotum prolonged posteriorly into a point partly covering mesonotum; rudimentary wing-pads distinguishable; head and thorax densely pilose, abdomen sparsely pilose; no dorsal spines on thorax, those on abdomen short.

Head broad, slightly produced forward, hairy; frontal tubercles almost obsolete; eyes prominent, red-brown; ocelli white, not prominent; clypeus long and triangular, faintly punctate and sparingly pubescent, suture at base very distinct; antennæ prominent. Thorax broader than abdomen, brown with scattered white punctures densely pilose; pronotum well developed posteriorly, covering one-half of mesonotum; meso and metathorax subequal, lateral margins produced to form first, evidences of wing-pads; no median dorsal bristles on thorax. Abdomen with eight distinct segments besides anal tube; each segment except the last bearing a pair of short heavy dorsal spines, each spine ending in a fine, hair-like bristle; last abdominal segment darker in color and densely pilose; anal tube thick, heavy, often greatly distended; under side of abdomen reddish-white. Legs very light mottled brown, white below; tibiæ and tarsi somewhat hairy; claws strong, ferruginous.

Fourth Instar.

Measurements: Length 3–4.5 mm.; maximum width 1.2–1.6 mm.

Light ferruginous brown; head large; pronotum entirely covering mesonotum; wing-pads of first and second pairs of wings reaching equidistant posteriorly and covering half of first abdominal segment at lateral margin.

Head prone; frontal tuberosities scarcely visible; densely pubescent; eyes prominent, reddish-brown; ocelli small, white; antennæ prominent, short and heavy, ending in a fine bristle; beak reaching to third abdominal segment. Thorax brown, pubescent; pronotum greatly developed, covering mesonotum above; wing-pads of both segments well developed, their tips extending equally far posteriorly. Abdomen light brown, posterior margins of segments darker; sparingly pubescent; each segment except the last armed with a pair of three branched spines above and a transverse irregular growth of hairs around middle. Undersurface of body pinkish-white with patches of brown at lateral margins of abdominal segments below. Legs light mottled brown externally, white below; femora, tibiæ and tarsi hairy; claws strong and ferruginous.

Fifth Instar.

Measurements: Length 4.5–5.5 mm.; maximum width 1.8–2.2 mm.

Large, robust, light ferruginous marked with gray, pronotum covering both meso and metanotum above; abdomen with six pairs of heavy branched spines extending down dorsal line; entire body finely pubescent.

Head twice as broad as long, head with eyes wider than the thorax behind it; clypeus slightly protruding forward; beak reaching hind coxæ; antennæ prominent, three jointed; eyes large, red with white borders, curved round the anterior shoulders of the prothorax; ocelli small, white; dark spot on front above each ocellus. Prothorax well developed, light brown with gray patches, hairy. Pronotum greatly extended posteriorly, covering dorsal surfaces of both mesothorax and metathorax Wing-pads fully developed, extending to third abdominal segment. Abdomen light ferruginous brown with darker fascia around the middle of each segment; armed with six pairs of heavy, many-branched spines above; last abdominal segment robust and densely pubescent; anal tube straight and black with fringe of fine hairs at tip; underside of abdomen white with reddish lines margining the segments. Legs light mottled brown, hairy; claws heavy, fuscous.

Adult Female.

Measurements: Length, including tegmina, 5.7 mm.; width between humeral angles 2.6 mm.

Light chocolate brown with deep brown and yellow-white markings; pubescent; punctate; without pronotal horn; dorsum regularly rounded, sharp at posterior apex; tegmina hyaline, cloudy at base and near middle, extending beyond the posterior process, costal area punctate, terminal cell with straight transverse base; legs and undersurface of body uniform luteus.

Head wider than long, yellow brown, slightly punctate and sparingly pubescent; eyes prominent, dark brown; ocelli pearly white, equidistant from each other and from the eyes and situated on a line drawn through center of eyes; antennæ short, three-jointed, the last segment fine and hairlike; clypeus extending slightly below marginal line of loræ when viewed from the front, sparingly pilose; beak reaching hind coxæ. Pronotum finely punctate, pubescent, gradually rounded above the head; humeral angles rounded, not prominent, extending beyond the eyes to a distance equal to the width of the latter; faint percurrent, median carina; posterior process strong, acute, sharp at tip, extending as far as the terminal cell of the tegmina. Color of pronotum yellowish-brown with markings of dark brown and white. Irreg-

ular brown spots on front of pronotum over the eyes; diagonal light band extending on each side from apex of metopidium to lateral margin, this band having a dark brown posterior border; broad transverse light band just before posterior apex, this band bordered before and behind with dark brown. Tegmina subhyaline, extending beyond the apex of the posterior process of the pronotum; basal area fuscous and punctate; costal cell punctate for almost its entire length; fuscous cloud in middle of tegmina continuing the dark pattern of the pronotum above. Underside of abdomen orange yellow; sheath of ovipositor yellow. Pectoral regions and legs uniform yellow. Femora pubescent; tibiæ pubescent and armed with very small, black-tipped spines; tarsi fuscous; claws ferruginous.

Adult Male.

Measurements: Length 4.6 mm.; width 2.3 mm.

Smaller and darker than the female and having the dorsal line slightly depressed just behind middle as seen from the lateral aspect. Color deep brown, almost black; fascia narrow but conspicuous on account of the dark color around them. Tegmina with veins very heavy and black. Undersurface of abdomen dark brown, segments margined with white. Legs uniform dark brown; femora smooth; tibiæ with yellowish pubescence; tarsi and claws fuscous.

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EXPLANATION OF PLATE.

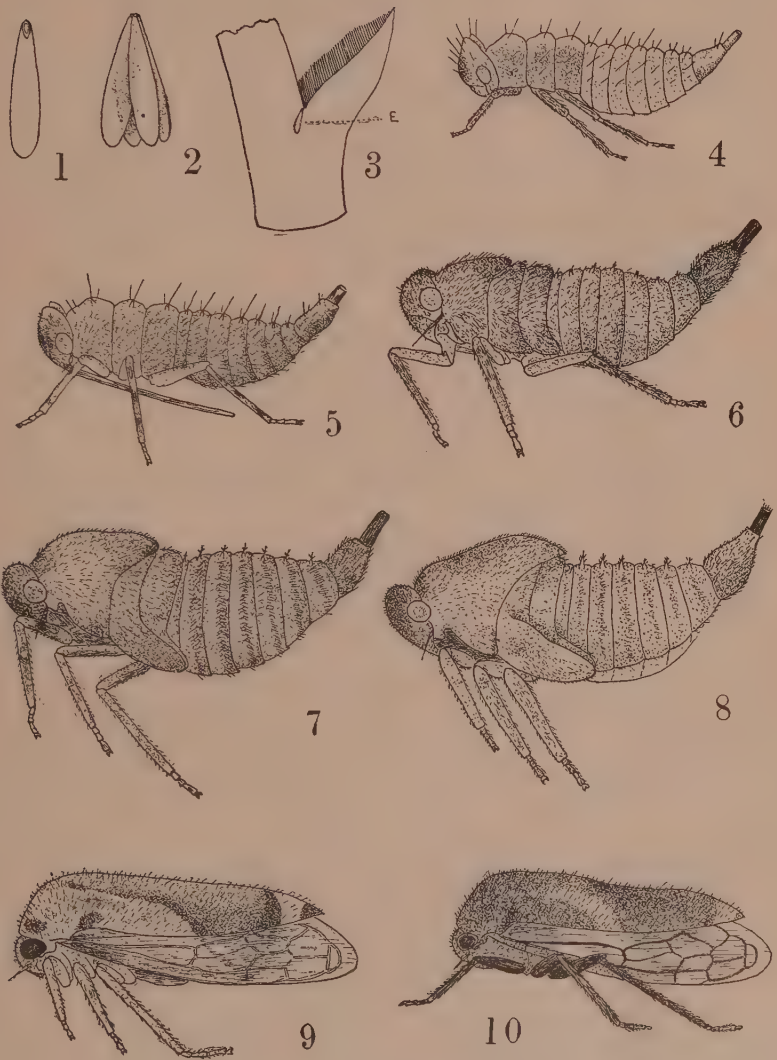
Fig. 1. Egg.
1. 2. Egg-mass.
3. Longitudinal section of stem showing position of egg at base of old bud scale.
4. First instar.
5. Second instar.
6. Third instar.
7. Fourth instar.
8. Fifth instar.
9. Adult female.
10. Adult male.

NOTE ON THE SPECIES OF THE GENUS ACROCERA.

By Charles W. Johnson,
Boston Society of National History, Boston, Mass.

Most of the species of this genus have remained practically unknown since they were described. This is undoubtedly due to poor description on the one hand and to the scarcity of material on the other. Since obtaining my first specimen in 1895, only seventeen additional specimens have come under my observation, representing perhaps seven species. The variable and vestigial character of the venation offers an attractive field for study if only sufficient material could be obtained. The species, so far as known, parasitize the ground spiders of the genera Lycosa and Amaurobius, and no doubt a number could be obtained by raising the various species of spiders of these genera. The late Dr. T. H. Montgomery in conducting some studies on the Lycosids, bred a number of *Acrocera fasciata*, and I remember he said that he could detect those which were parasitized, long before there was any other indication, by their weaker and more poorly constructed webs, the parasite evidently affecting the functions of the spinneret.

The brief Latin descriptions by Westwood (Trans. Ent. Soc., London, V, 91, 1848), are very trying, and the positive identification of some of his species seems almost impossible with so little material, especially from the southern states—three of his species being described from Georgia. I can therefore present only the following provisional table and notes, trusting that they may lead to a further study of this interesting genus:



FUNKHOUSER—*Vanduzea arquata Say.*

Table of Species.

Dorsum of the thorax marked with yellow 2
Dorsum of the thorax entirely black 3
2. Thorax with two elongated spots or stripes (Wash.) ..... **liturata** Will.
Thorax with two cuneiform markings (N. Y., N. H.) ..... **subfasciata** Westw.
3. Venation typical (N. Y., Mass., Me.) ..... **bulla** Westw.
Venation not typical 4
4. Second longitudinal vein wanting 5
Second longitudinal vein rudimentary, present only at the apex (D. C., Pa., Que., Mass.) ..... **bimaculata** Loew
5. Third longitudinal vein branched and the anterior cross vein present 6
Third longitudinal vein with the branch and the anterior cross vein obsolete or wanting 7
6. Abdomen with a complete uninterrupted fascia on all the segments (Ga., Pa., Ill., Mass.) ..... **fasciata** Wied.
Abdomen with irregular maculation on the third and fourth segments (Ga., Conn., Vt., N. H.) ..... **nigrina** Westw.
Abdomen yellow, except at the very base; veins extremely light (Wis., Me.) **obsoleta** V. d. Wulp
7. Abdomen black, wings fuscous at the base (Ga.) ..... **fumipennis** Westw.
Abdomen yellow, base of the segments black; wings hyaline (Ga., Md., Pa., Wis.) ..... **unguiculata** Westw.

Acrocera subfasciata Westwood. Figure 1.

A specimen collected by J. C. Bridwell at Pelham, N. H., September 8, 1905, agrees well with Westwood's description, except that the yellow cuneiform markings on each side of the anterior part of the thorax extend in two very narrow subdorsal lines to the base of the scutellum, a likely variation, apparently resembling *A. liturata* Will., which may prove to be an extreme variation. The abdomen is yellow with dorsal and lateral spots of black, those on the second segment narrowly connected with those on the sides. Venation typical. As Westwood lays considerable stress on obsolete veins and Williston does not mention the venation of *A. liturata*, I take it for granted that both are typical in this respect.

Acrocera bulla Westwood.

Again I take it for granted that Westwood's species has typical venation. A specimen collected at Bailey's Island, Me., August 20, 1915, by Dr. G. M. Allen agrees well with the description. The specimen referred to has very light yellow markings, those on the second segment consisting of two widely separated triangular spots on the posterior margin; the third segment

similarly marked, except that the spots are quadrate and very narrowly separated at the posterior margin; fourth segment largely yellow, with a dorsal triangle and small triangles at the anterior angles, black; venter black, with narrow white posterior margins on all the segments. Legs a very light yellow, last joint of the tarsi and the claw black, halteres yellow. Length, 4.5 mm.

Fig. 1

Fig. 2

Fig. 3

Fig. 4

A second specimen collected by Stanley W. Bromley, at Southbridge, Mass., has dark yellow markings, the two widely separated spots on the second segment are quadrate, those on the third triangular and narrowly connected, and those on the fourth quadrate and also narrowly connected at the posterior margin. The wings and squamae are a slightly darker hyaline than the Maine specimen. It is also more robust but measures about the same in length owing to a slight contraction of the abdomen.

A third specimen in the Museum of Comparative Zoölogy, from Maine (Osten Sacken), has the markings on the abdomen reduced in size, those on the second segment consisting of two small spots, while those on the third are somewhat larger and widely separated.

Acrocera bimaculata Loew. Figure 2.

This species is most readily recognized by its rudimentary second longitudinal vein, as the markings on the abdomen are somewhat variable. A specimen from Levis Co., Quebec (G. Chagnon), agrees with the type in having two large maculations on the posterior margin of the fourth segment. A specimen collected by Mr. C. A. Voelker at Clifton, Delaware Co., Pa., has two additional

small spots on the posterior margin of the third segment. A third specimen, collected by Stanley W. Bromley at Southbridge, Mass., June 25, 1915, represents a small male, with only a margin of yellow at the posterior angle of the fourth segment. The wings are light hyaline. Length, 4 to 6 mm.

Acrocera fasciata Wiedemann. Figure 3.

This is the best known species. It has been bred from *Lycos ocreata* Hentz (*L. stonei* Montg.) near Philadelphia, Pa., by Dr. T. H. Montgomery (PSYCHE, XI, 17, 1904) and by Mr. J. H. Emerton from *Amaurbius sylvestris* at Waltham (PSYCHE, V. 404, 1890). A specimen collected by Mr. C. A. Frost at Framingham, June 9, 1915, represents a small male, 3 mm. in length. The scutellum is black except the apex, and the wings are a clear not a brownish hyaline. The uninterrupted bands on all of the segments readily distinguish the species. The female measures 5 mm. and has the scutellum entirely yellow. The wing figured shows an adventitous cross vein between the forks of the third vein, present on the left wing of one specimen.

Acrocera nigrina Westwood.

I am referring to this species four specimens which show some variation in the abdominal markings but no more than would probably exist in a large series. One has two large spots on the third segment, very narrowly connected on the posterior margin. The other three have small irregular spots. In all of the specimens the fourth segment is largely light yellow. Legs yellow, femora and tibiæ obscurely brown on the middle third; squamæ margined with brown; wings pale brown, the second longitudinal vein wanting, a character probably overlooked by Westwood. The specimens measure from 4 to 5 mm.

These four examples are from the following localities: Darien, Conn., June 12, and Bennington, Vt., June 18, 1915 (C. W. Johnson); Shirley Hill, N. H., June 17, 1911 (F. W. Grigg); Quebec (Provancher) Museum of Comparative Zoölogy. The latter has the usual abdominal markings, but the second longitudinal vein is indicated by a short stub at the base and by two short, interrupted dashes on one wing and one on the other midway between the base and where the apex should be. The entire absence of

yellow markings on the second segment would indicate that it belongs here rather than to *A. bulla*, while the great amount of yellow on both the third and fourth segments bars it from *A. bimaculata*. This characteristic suggests, however, that bulla, bimaculata and nigrina may possibly represent extreme variations of one species, but much more material would be necessary to prove this.

Acrocera obsoleta Van der Wulp.

A. obsoleta V. d. Wulp. Tijdschr. v. Ent., II, 2nd. ser., p. 139 pl. 3, f. 17, 1867.

A specimen which I am referring to this species was taken by Mr. A. P. Morse at Orona, Me., August 5, 1915. The abdomen is bright yellow except for a narrow basal margin, a dorsal triangle at the base of the third segment, and a small anal spot of black; venter yellow, segment with narrow, whitish, posterior margins and lateral spots of black. Wings whitish hyaline, with very pale veins, giving them an obsolete appearance. Length, 5.5.

Van der Wulp in figuring the wing indicates all but the auxiliary and first longitudinal veins by dotted lines; "alarum nervis, præter nervos longitudinales duos priores obsoletissimis; furca in apice petiolo breviori," would, however, indicate that they were present and all are shown except the second longitudinal vein. The branch of the third longitudinal vein and anterior cross vein are the first to disappear as in the case of *A. unguiculata*.

Acrocera unguiculata Westwood. Figure 4.

I am referring to this species two specimens which have two important characters in common, *i. e.*, the branch of the third vein and the anterior cross vein are wanting. The smaller specimen which was taken at Fort Washington, Md., May 26, 1895, measures 3 mm. in length. The third segment has a large, yellow, transverse spot on the posterior half, not reaching the lateral margins; the fourth segment is yellow except for a narrow anterior margin. Wings whitish hyaline. The larger specimen measuring 5 mm., was collected at Lehigh Gap, Pa., July 10, 1897 (H. L. Viereck). The yellow on the abdomen covers all of the fourth, all but a narrow anterior margin on the third, and the posterior dorsal fourth, of the second segment. The wings are brownish hyaline. The abdominal markings agree fairly well with Westwood's description

and "alarum venis fere obsoletis" would certainly apply to the venation. Another feature common to both specimens is the entirely light yellow tarsi, only the claws being black. All of the other species have the terminal joint blackish.

Acrocera fumipennis Westwood.

This may prove to be only a dark form of the preceding species. The entire absence of yellow markings in the description and the statement that the base of the wings is smoky brown, cannot however apply to those I have seen with obsolete venation.

A NEW BOG-INHABITING VARIETY OF FORMICA FUSCA L.

By William Morton Wheeler.

Several entomologists have recently called attention to the ants inhabiting peat-bogs in Northern Europe. Nylander, as long ago as 1846, described a peculiar, shining black *Formica* as *F. picea* from Sphagnum bogs in Finland[1] and this species has since been collected in Germany, Denmark, England, Russia and Siberia but has been usually referred to *F. gagates* Latreille, a form described from France. Emery[2] first definitely recognized the two forms as distinct, though he regarded both as subspecies of *fusca*. He gave the distribution of *gagates* as Southern Europe and Asia Minor and that of *picea* as Northern Europe and Asia as far as China, whence it had been recorded by Forel under the name of *filchneri*. Forel has since described a var. *formosæ* of *picea* from the Island of Formosa.[3]

In 1913 Donisthorpe found *picea* in England nesting in Sphagnum,[4] in 1914 Adlerz found it in the same situations in Sweden,[5] and during the same year and 1915 Bönner published two inter-

[1] Adnotationes in Monographiam Formicarum Borealium Europae, Act. Soc. Sc. Fenincæ, 2, 1846, pp. 875-994 and Additamentum Adnotationum in Monogr. Form. Bor. Eur. *Ibid.*, pp, 1048–1062.

[2] Beiträge zur Monographie der Formiciden des paläarktischen Faunengebietes, VII, Deutsch Ent. Zeitschr. 1909, pp. 179–204, 16 figs.

[3] H. Sauter's Formosa-Ausbeute: Formicidæ II. Arch. f. Naturg. 79, 1913, pp. 183–202.

[4] Myrmecophilous Notes for 1912. Ent. Record 25, 1913, pp. 61–68, 89–97.

[5] Formica fusca picea Nyl. en Torfmossarnas Myra. Ark. f. Zool. 8, 1914 p. 1.

esting papers on the habits of *picea* as observed in the Sphagnum bogs near Copenhagen.[1] He describes in detail its small mound nests in the clumps of wet Sphagnum and shows how it hibernates in these nests, which are frozen solid during the winter months. Bönner's observations induced Forel to search for *F. picea* in some peat-bogs near Yvorne, Switzerland, a country from which the ant had not been recorded. He succeeded in finding it, and from a study of his specimens concluded that it is to be regarded as a distinct species.[2]

The wide distribution of *picea* in boreal Eurasia led me to hope that I might find it or a closely related form in the peat-bogs of New England. I therefore gladly accepted the invitation of Prof. R. T. Fisher, director of the Harvard Forest, to explore with him a large peat-bog at Petersham, Mass. This bog is at an altitude of over 700 feet. Its flora has a pronounced boreal facies as shown by the following lists of plants which were abundant in such portions of it as we could conveniently enter: *Picea mariana* and *canadensis*, *Larix laricina*, *Chamædaphne calyculata*, *Kalmia angustifolia* and *polifolia*, *Ledum grœnlandicum*, *Rhododendron canadense* and *Oxycoccos oxycoccos*. I did not find *picea* in this bog but instead a variety of *fusca L.*, evidently distinct, of which I had received specimens from Sphagnum bogs in other localities. I had erroneously included this form in *F. fusca* var. *gelida* Wheeler in my recent "Revision of the Genus Formica (Linné) Mayr."[3] Only one small colony of the ant was found and this was nesting under a log in damp, peaty soil. On again examining my series of *gelida*, I find that all the specimens cited from Eastern North America, *i. e.*, from Labrador, Quebec, Newfoundland, Ontario and Nova Scotia, and a few specimens mostly taken in Sphagnum bogs in New Hampshire, Maine, Michigan and New York and partly referred to *F. fusca* var *subœnescens* Emery, belong to this distinct unpublished variety which differs from the true var. *gelida* in the pubescence and sculpture of the gaster and the color and sculpture of the thorax. I have seen only worker and female specimens answering to the following description:

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[1] Formica fusca picea eine Moorameise. Biol. Centralbl. 34, 1915, pp. 59–76, 6 figs. and Die Ueberwinterung von Formica picea und andere biologische Beobachtungen. *Ibid.* 35, 1915, pp. 65–77, 1 pl.

[2] Deux Nouveautés Myrmécologiques, September 1, 1914, 1 p. (author's publication).

[3] Bull. Mus. Comp. Zoöl. 53, 1913, pp. 379–565, 10 maps.

Formica fusca L. var. algida var. nov.

Worker. Length 3.5–5.5 mm.

Head not longer than broad, except in the smallest individuals, slightly narrowed in front, with rather convex sides. Epinotum distinctly and often sharply angulate in profile. Petiole convex in front, flattened behind, with transverse, feebly rounded, entire border, precisely as in the vars. *neorufibarbis* and *gelida*. Upper surface of head and thorax much more opaque and more coarsely shagreened than in these varieties. Frontal area shining. Gaster much more shining than in the varieties mentioned, though sharply shagreened, its hairs short, blunt and sparse, its pubescence much sparser and distinctly longer and coarser, except on the anterior portion of the first gastric segment, where it is very fine and dense as in *gelida* and *neorufibarbis*. Pubescence on head, especially on its sides, long and dilute. Color variable; dark reddish brown; cheeks, mandibles and clypeus paler; gaster and posterodorsal portions of head and in many specimens also the thorax and petiole, black. Thorax, however, usually paler than the head and in many Newfoundland specimens pale brownish red, as in *neorufibarbis*, but with a dark cloud on the pro- and mesonotum as in *gelida*. In these specimens the pale color extends also to the petiole and base of the first gastric segment. Other specimens have the thorax dark brown, with paler and more reddish sutures. Legs reddish brown, usually with the coxæ, femora and tibiæ dark brown or blackish, except at the articulations. Antennæ reddish brown, funiculi infuscated, except at the base.

Female. Length 6.5–6.8 mm.

Resembling the worker in pilosity and pubescence, except that the latter on the gaster is even more dilute and longer and the surface of this region is more delicately shagreened and more shining. The petiole is broader and more compressed anteroposteriorly, with more acute border, which is entire and often slightly produced upward in the middle. The color is similar to that of the lightest workers, the thorax, petiole, legs and anterior and ventral portions of the first gastric segment being clear brownish red. Pronotum with brownish anterior and posterior borders, pleuræ more or less clouded with brown; mesonotum with three more or less sharply defined, longitudinal dark brown or blackish blotches; metanotum and posterior border of scutellum more or less infuscated. Wings colorless, with brown veins and apterostigma.

Maine: Kittery Point, in Sphagnum bog (R. Thaxter), type locality.

New Hampshire: Lafayette, 4,000 feet in Sphagnum bog (J. H. Emerton); Mt. Washington, 3,840 feet (W. Reiff).

Massachusetts: Petersham, in Sphagnum bog (Wheeler).

New York: Bedford, nesting in dead leaf of *Sarracenia*, in Sphagnum bog (Wheeler).

Michigan: Porcupine Mountains and Isle Royale (O. McCreary).

Ontario: Kenora (J. C. Bradley).

Quebec: Saguenay R. (Geo. Engelhardt); Anticosti I., Mingan

I. and Neapisca I. (Saml. Henshaw); East Maine R. (A. Skinner).

Nova Scotia: Digby (J. Russell).

Newfoundland: Bay of Islands (L. P. Gratacop.), Spruce Brook, Port Saunders, Port au Croix (Amer. Mus. Nat. Hist.); Seldome Come Bay, Fogo I. (O. Bryant).

Labrador: Square I. (A. S. Packard); St. Lewis Inlet.

The varieties *neorufibarbis*, *gelida* and *algida* are all very closely related boreal *fusca* forms, the first, as I have noticed during the past summer, common in the Sierra Nevada Mountains, Selkirks and the Canadian Rockies at elevations between 4,000 and 5,000 feet, the second ranging from Alaska to higher elevations in the Sierra Nevada and Rocky Mountains of Colorado and New Mexico, and the last peculiar to boreal eastern North America, where it occurs at low elevations from Labrador to New York and as far west as Western Ontario, but, so far as known, only in peat bogs within the United States.

Besides *F. fusca* var. *algida* there are several species of ants that nest frequently or by preference in the cold bogs of the Northern States and British America. The most frequently met with in such situations are, according to my observations, the following: *Myrmica brevinodis* Emery vars. *canadensis* Wheeler, and *sulcinodoides* Emery, *Myrmica scabrinodis* Nyl. var. *detritinodis* Emery and subsp. *schencki* Emery var. *emeryi* Forel, *Leptothorax* (*Mychothorax*) *emersoni* Wheeler and its subsp. *glacialis* Wheeler, *Crematogaster lineolata* Say and its subsp. *pilosa* Pergande, *Dolichoderus* (*Hypoclinea*) *taschenbergi* Mayr var. *aterrimus* Wheeler, *Lasius niger* L. vars. *sitkaënsis* Pergande and *neoniger* Emery, *Lasius* (*Chthonolasius*) *umbratus* Nyl. subsp. *minutus* Emery, *Formica fusca* L. (typical), *Formica cinerea* Mayr vars. *neocinerea* Wheeler and *altipetens* Wheeler, *Camponotus herculeanus* L. var. *whymperi* Forel and subsp. *ligniperda Latr.* var. *noveboracensis* Fitch. In the bog at Petersham, Mass., a worker major of *Camponotus whymperi* was found in the liquid contents of a pitcher plant leaf (*Sarracenia purpurea*). It is probable that this list will be considerably increased by further attention to the ants inhabiting our northern peat-bogs.

REMARKS ON COLLECTING AT LIGHT, WITH A LIST OF THE COLEOPTERA TAKEN.

By C. A. Frost,
Framingham, Mass.

After I had settled in South Framingham, it was not long before I discovered that I had selected a favorable room for my "bug-den," since moths and other insects soon began to visit me by way of the windows while at work on my collection during the summer evenings.

The house is so situated that from my room, an attic one on the third floor, one looks out over gardens, yards, and shade trees, toward the west. It was formerly shaded by several European spruces and a large elm, but one of the spruces is almost dead and the elm has been cut down at the request of a "back-to-the-soil" enthusiast whose crop of weeds has probably furnished me with some fine micro-lepidoptera. The afternoon sun beats in the two windows and, in spite of the closed blinds, renders the room uninhabitable to anyone but a "bug-catching crank" long after the sun has set. The insinuations in regard to my mental condition become more emphatic as the summer progresses and the heat drives the rest of the household to the piazza, while I insist on retiring to my room for the evening collecting. The heat caused me much trouble with my point mounting so that I discontinued the use of shellac for some time and adopted an English cement which sets very quickly and does not soften. I have since concluded that it was a poor quality of shellac which softened with the heat and allowed the insects to drop off or twist about. When I returned from a vacation trip to Colorado after the extremely hot period of July, 1911, to find my new boxes stuck together and a penholder more than half buried in a cake of paraffine on my table—I was mighty glad I went. Dozens of my shellac-mounted specimens have had to be remounted as a result of that summer's heat.

The town has grown very rapidly since I came here in 1904 and is now an embryo city with houses springing up on every vacant lot, so that I suspect a falling off in the number of specimens that

come to my light. I have used an ordinary kerosene lamp with a reflector, sometimes turned to throw the light out of the window, but more often to reflect onto my work; and the insects seem to come in just as readily. I have also tried setting the lamp on a chair before the window with a sheet of glazed paper hanging over the back behind the lamp, with some success. Nothing comes to light on moonlight evenings and a dark, muggy night is, of course, the best. I have taken many Lepidoptera during a pouring rain.

The most abundant species of moths belong to the genera *Leucania*, *Hadena*, *Mamestra*, *Feltia*, and *Crambus*. Certain Geometridæ, as *Xanthorhoea ferrugata*, *Gypsochroa designata*, and *Hydriomena multiferata*, have been common in the past but they have almost disappeared during the last few years.

It is a matter of much regret that I have not kept a complete record of the many species of Lepidoptera taken on the table and the walls of my room. Many of the species immediately hide behind the boxes and in obscure nooks and appear next morning on the screens or between the curtain and the glass of the windows. Others are never seen until picked up dead on the floor. Nearly all the specimens fly about the light for a time and then, especially the micros, settle down on the table or fly to the ceiling to remain until disturbed. A favorite resting place for the species of *Hadena* and *Leucania* is the dark varnished door to the hall, perhaps on account of the draft through the crack next the jamb.

For some time I used to identify the moths as they came in, and then paper at once or reserve for mounting the next morning, but one evening a robust *Hadena* entered an open double box of Lepidoptera and quietly remained there until the box was shut up and replaced on the shelf. Some days later on opening the box I found that its work had sufficiently identified it as *devastatrix*.

I have generally collected from dark to midnight but have remained as late as 2 a. m. on especially favorable nights. The specimens come intermittently—in bunches best expresses it—and sometimes a dozen specimens will be bumping about the room, then hardly one for half an hour or so. On some evenings the ceilings will be dotted with hundreds of minute Diptera and Hemiptera, and yet it is seldom that a mosquito finds its way in. I once counted 94 specimens of small Diptera stuck on a quadrant of the base of the lamp, a total of 376 for the whole base. I thought it a hopeless task to count those on the table.

Late in the summer a species of lace-winged fly (*Chrysopa*) becomes common and I was once surprised to receive a sharp bite on the arm from one of these delicate insects.

The largest insects that have come in were *Telea polyphemus* and *Prionus pocularis.*

The list of Coleoptera is very small compared with the species of Lepidoptera that have been taken, but it may be of interest to record them for many of the species (as *Macrobasis torsa* and *Liopus alpha*) must have flown at least a mile from their breeding places into the thickly settled part of the town.

List of Coleoptera Taken at Light.

Bembidium variegatum Say, July 28, 1913. *Amara apricarius* Payk., August 23, 1910. *Platynus* Sp? (near *moerens* Dej.), June 29, 1913. *Platynus aeruginosus* Dej., May 27, 1908. *Lebia atriventris* Say, May 28 and June 19, 1908. *Lebia viridipennis* Dej. June 19, 1908. *Lebia ornata* Say, July 4, 1909. *Lebia scapularis* Dej., September 4, 1910. *Pinacodera platicollis* Say, October 1, 1910. *Chlaenius pennsylvanicus* Say, May 24, 1908. *Chlaenius tricolor* Dej., May 24, 1908. *Harpalus pennsylvanicus* DeG., June 28, 1908; August 13, 1912. *Harpalus erythropus* Dej., July 24, 1911. *Stenolophus ochropezus* Say, May 24 and 27, 1908; May 16, 1909; July 1 and August 4, 1910; July 31, 1911; April 21, 1912; July 28, 1913. *Agonoderus pallipes* Fab., July 1, 1907; July 2 and 28, 1913, and many others not recorded. *Agonoderus lineola* Fab., May 24, 1908; July 18, 1909. *Anisodactylus terminatus* Say, July 28, 1913. *Anisodactylus sericeus* Harr., May 27, 1908.

Hydrocharis obtusatus Say, July 29, 1913. *Philhydrus ochraceus* Mels., July 28, 1913.

Necrophorus americanus Oliv., May 31, 1908. *Necrophorus orbicollis* Say, October 4, 1910. *Agathidium oniscoides* Beauv., May 27, 1908.

Oxytelus sculptilis Grav., May 24, 1908. *Acylomus ergoti* Casey, June 8, 1908. *Hippodamia 13-punctata* L., August 23, 1912. *Adalia bipunctata* L., July 7, 1908. *Henoticus serratus* Gyll., August 8, 1913. *Lathropus vernalis* Lec., July 4, 1908. *Litargus sexpunctatus* Say, July 26, 1912. *Typhœa fumata* L., May 28, 1908; July 31, 1911; August 21, 1912 (two specimens).

Cryptarcha ampla Er., June 23, 1904. *Melanopthalmus obtusa* Lec., April 5, 1910; September 8, 1911. *Melanopthalmus distinguenda* Com., May 29 and July 4, 1908. *Prionocyphon discoideus* Say. (?), July 5, 1904.

Entomophthalmus rufiolus Lec., June 28, 1910. *Melanotus communis* Gyll., May 24, 1908; May 6, 1913. *Melanotus trapezoideus* Lec., July 15, 1911. *Melanotus sagittarius* Lec., May 30, 1908. *Limonius basillaris* Say, July 15, 1911. *Athous cucullatus* Say, June 27, 1908. *Asaphes memnonius* Hbst., June 27 and July 4, 1908.

Podabrus tricostatus Say, June 9, 1910. *Podabrus rugulosus* Lec., June 27, 1908; June 30, 1910; June 29, 1913. *Podabrus basillaris* Say, May 29 and 31, 1908; June 4, 1913. *Podabrus simplex* Coup., May 29, 1908; June 3, 1912. *Silis percomis* Say, May 23, 1911. *Telephorus bilineatus* Say, May 25, 1908.

Cregya oculata Say, August 5, 1910 (two specimens). *Ernobius mollis* L., May 29, 1908; July 2, 1913. *Lucanus dama* Thunb. Several times, no record at hand.

Trox unistriatus Beauv., August 10, 1907. *Trox scaber* L., May 29, 1912. *Dichelonycha elongata* Fab., June 4, 1912. *Dichelonycha albicollis* Burm., May 25, 1910. *Dichelonycha diluta* Fall (?), June 1, 1912. *Serica vespertina* Gyll., June 19, 1908. *Serica sericea* Ill., June 9, 1910. *Diplotaxis sordida* Say, July 29, 1913. *Diplotaxis atlantis* Fall, May 25, 1908. *Lachnosterna fusca* Fröl., May 19, 1907; May 7, 1910; and many other records. *Lachnosterna nova* Smith, June 22, 1908; May 25, 1910; May 25, 1912. *Lachnosterna hirticula* Knoch, May 25 and 29, 1910; one of the most common visitors. *Pelidnota punctata* L., July 17, 1911; August 9, 1912. *Ligyrus relictus* Say, September 7, 1910 and several other records.

Orthosoma brunneum Forst., June 28, 1913. *Prionus pocularis* Dalm., July 30, 1911. *Criocephalus agrestis* Kirb., July, 1913. *Elaphidion villosum* Fab., July 18, 1909; May 6, 1913. *Xylotrechus colonus* Fab., July 14, 1912. *Monohammus titillator* Fab., July 29, 1913. *Monohammus confusor* Kirby, July 23, 1913 (male and female). *Liopus alpha* Say, July 10, 1909; June 25 and 30, 1913.

Gastroidea polygoni L., July 6, 1908. *Diabrotica vittata* Fab., August 25, 1910 and many other records. *Galerucella luteola*

Muls., August 13, 1912, and many other records. *Oedionychis limbalis* Melsh., May 3, 1913.

Tenebrio molitor L., July 6, 1908. *Strongylium tenuicolle* Say, June 27, 1908. *Hymenorus discretus* Casey, June 28, 1908; August 24, 1909; June 25, 1913. *Hymenorus niger* Melsh., June 20, 22, and 24, 1908. *Hymenorus melsheimeri* Casey, August 4, 1910. *Mycetochares megalops* Casey, May 30, 1911. *Carebara longula* Lec., July 10, 1907. *Orchesia castanea* Melsh., August 13, 1912. *Salpingus virescens* Lec., August 12, 1912. *Capnochroa fuliginosa* Melsh., July 17, 1912. *Glipodes sericans* Lec., August 4, 1910. *Mordellistena dimidiata* Helm. July 4, 1908. *Notoxus anchora* Hentz, July 4, 1908; June 28, 1910. *Notoxus monodon* Fab., August 17, 1911. *Dendroides concolor* Newm., June 3, 1912. *Macrobasis torsa* Lec., June 15, 1908.

Hylobius pales Hbst., May 24, 1908; April 17, 1910. *Pachylobius picivorus* Germ., August 14 and September 3, 1910. *Conotrachelus nenuphar* Hbst., May 30, 1908. *Conotrachelus elegans* Say, May 27, 1908. *Cryptorhynchus bisignatus* Say, June 29, 1913. *Balaninus uniformis* Lec., August 19 and September 5, 1912. *Crypturgus atomus* Lec., August 5, 1910. *Cratoparis lunatus* Fab., July 31, 1911.

AN IMPROVED COLLECTING BOTTLE.

By C. N. Ainslie,
U. S. Department of Agriculture, Bureau of Entomology, Cereal and Forage Insect Investigations.

In common with many other entomologists, I have been greatly annoyed by the condensing of the moisture on the inside of my collecting bottle. I notice that some entomologists make a hole in the cork and place a lump of cyanide therein, but in my experience it is only a matter of a few days until the cork becomes damp and sticky and unfit for use, especially in rainy weather.

The writer has recently adopted the plan of sinking a 9 x 36 mm. shell vial in the cork, with the mouth of the vial opening into a larger bottle or tube, whichever may be used. If these 9 x 36 mm. vials are too long they may be cut off so that the opening will be flush with the surface of the cork, although I prefer to have them

project a little above the cork, place the cyanide in this small vial and stop the mouth of the vial, above the poison, with a cotton plug; or the smallest shell vials, 7 x 25 mm., can be used for the same purpose when sunk in the corks of ordinary 2 dram vials, or similar ones. Such vials are easier to obtain and have greater durability for field collecting than the larger tube vials which so often break without any provocation. In order to catch the eye more readily, the upper surface of these poison-filled corks may be marked with a large ink "P," and there is less chance of them being used for material intended for rearing. Where shell vials are not to be had, it would be easy to cut a short length of glass tubing and seal one end in a lamp, inserting this sealed end in the cork as if it were a small vial.

When working in the field at a distance from supplies, it is possible to carry two or three corks containing these small vials without the poison, or even with the poison, tightly corked. As they are needed, uncork and insert in the killing bottle. I am using the large tube vials for killing and these have corks that are interchangeable. With such a holder for the poison there is much less annoyance from disagreeable moisture than with other forms of poison-bottles.

This idea is probably not a new one, indeed Prof. C. T. Brues informs me that he has, for a number of years, used a bottle similar to the one described above. He further adds that if a small amount of crystallized boracic acid be added to the cyanide it causes more rapid decomposition of the cyanide and an increased killing power results. The addition of the boracic acid was suggested to Professor Brues by Dr. George Bock of St. Louis, years ago.

LEPTURA EMARGINATA IN NEW ENGLAND.

Mrs. W. F. Buck of Melrose Highlands, Mass., brought to me a short time since a specimen of this fine longicorn beetle taken by her at Pequaket, N. H., about July 20, 1915. I have placed it, with the donor's sanction, in the New England collection of the Boston Society of Natural History.

A. P. Morse.

NOTES ON THE GENUS PHELISTER, MARS.[1]

By F. G. Carnochan.

While working on a revision of the Genus Phelister, of the United States, I noted a few points which it seems well to clear up at this time. Say, in 1825 described *Phelister subrotundus*, and also described a variety of *subrotundus* which he called var. A. This variety is characterized by having the fifth dorsal stria abbreviated in front. In the sixty-two specimens of *subrotundus*, which I have examined, I found seven of this variety, and consider that it merits a name.

Phelister subrotundus Say var. sayi, var. nov.

Oval, shining, black. Antennæ, legs, and elytra at each side and at tip, reddish brown. Front concave, punctured, frontal stria interrupted, but extending over the eyes. Thorax finely punctulate, more coarsely at the sides; marginal stria entire, fine; submarginal stria fine, distinct, abbreviated at base. Elytra with five entire striæ, the fifth extending just past the middle, and represented at the base by a single deep puncture; the sutural extending usually as far as the fifth. Propygidium sparsely punctured, pygidium sparsely and more minutely punctured. Anterior tibiæ multidenticulate.

The type of this variety is in my collection; paratypes in my collection and in that of Mr. C. A. Frost. I have seen also a second well marked variety which is, however, much more rare. In this variety the fourth dorsal stria is hooked towards the scutellum.

Phelister subrotundus Say var. frosti, var. nov.

Oval, shining, black. Antennæ, legs, and elytra at each side and tip, reddish brown. Front concave, punctured, frontal stria interrupted, but extending over the eyes. Thorax finely punctulate, more coarsely at the sides; marginal stria entire, fine; submarginal stria distinct, fine, abbreviated at base. Elytra with five entire striæ, the fifth distinctly hooked at base, the hook extending half way to the scutellum; sutural extending to middle or just in front of the middle. Propygidium sparsely punctured, pygidium sparsely and minutely punctured. Anterior tibiæ multidenticulate.

Described from three specimens; the type is in my collection; paratypes in the collection of Mr. C. A. Frost and the American Museum of Natural History.

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[1] Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 106.

Both these varieties seem to coincide in range with *Phelister subrotundus*.

Two more species, *vernus* Say. and *saunieri* Mars. require attention. These two are very close but differ in essential points. In *vernus* the thorax is very sparsely and unevenly punctate, as is the pygidium, the form of the insect is distinctly elongate, and all of the twenty-four specimens which I have examined have a distinctly reddish tinge, thus producing a rusty appearance, although the general color is black. *Saunieri* is proportionately broader, and has the thorax evenly and rather densely punctate, the pygidium is also evenly punctate but not very densely, the color is a clear, shining black without a trace of reddish.

I believe that the latter is extensively confused with *vernus* in collections as all the eight specimens that I have seen have been sent to me under that name.

EXCHANGE COLUMN.

Will exchange insects of various orders for Parasitic Hymenoptera from any part of the world.—C. T. Brues, Bussey Institution, Forest Hills, Mass.

Wanted. Ants from all parts of the world.—W. M. Wheeler, Bussey Institution, Forest Hills, Mass.

I pay cash or give American and exotic insects in exchange for fertile eggs of Catocala spp., *living* Catocala ♀ ♀ (captured specimens only), hibernating pupæ and larvæ of any other group of Lepidoptera.—William Reiff, 366 Arborway, Jamaica Plain, Boston, Mass.

Florida insects of all orders, also Fish, Batrachians, Reptiles, Shells and Marine Invertebrates sold by A. G. Reynolds, Gulfport, Florida.

New England Orthoptera identified. I wish to examine adult Orthoptera of all families from all parts of New England. Material will be identified for the privilege of retaining desired examples, for which good exchanges will be given, subject to approval of owner.—A. P. Morse, Wellesley College, Wellesley, Mass.

The undersigned will greatly appreciate receiving records of New Jersey species not listed in Smith's Insects of New Jersey.—Harry B. Weiss, 272 Hale St., New Brunswick, N. J.

Offered for cash, but exchange preferred. Fitch and early Illinois reports; Insect Life; Harris's Insect; many others.—J. E. Hallinen, Cooperton, Okla.

Histeridæ. North American Histeridæ identified or unidentified, desired in exchange for beetles of other families. F. G. Carnochan, Bussey Institution, Forest Hills, Massachusetts.

Hemiptera-Heteroptera. I desire specimens of this group from all regions, especially New England. I will give in exchange species of this and other orders (except Lepidoptera), and will identify New England material. Correspondence desired.—H. M. Parshley, Bussey Institution, Forest Hills, Mass.

Wanted: Psyche, Vol. VIII, No. 265 (May, 1898); No. 267 (July, 1898); No. 268 (August, 1898); Vol. IX, No. 300 (April, 1901). Address, giving price, Librarian, Stanford University, Cal.

Sarcophagidæ from all parts of the world bought or exchanged according to arrangement. North American material determined.—R. R. Parker, Entomological Laboratory, Massachusetts Agricultural College, Amherst, Mass.

Wanted: Transactions American Entomological Soc., Vol. 4; Entomological News, Vol. 2, Nos. 6 and 10; Vol. 8, Nos. 1 and 6; Vol. 9, Nos. 1 and 2; Vol. 10, No. 10; Vol. 11, Nos. 1, 3 and 5. Will purchase at reasonable price.—Howard L. Clark, P. O. Box 1142, Providence, R. I.

Wanted: Insects of any order from ant nests, with specimens of the host ants, from any part of the world; also Cremastochilinæ of the world. Will give cash or Coleoptera, Hymenoptera and Diptera from the United States.—Wm. M. Mann, Bussey Institution, Forest Hills, Boston, Mass.

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Errata and Corrigenda

p. 90. line 13 from top; after *predatory* insert ?

p. 91. line 6 from top; for *aquatic* read **littoral.**

p. 92. line 17 from bottom; for *always* read **generally.**

p. 92. line 14 from bottom; after *ocelli present* insert; except in a few Lygæidæ, which may be distinguished by the venation.

p. 93. line 1; after *27* insert foot-note:

The family Isometopidæ runs to this point and is to be distinguished from the following families by its Mirid-like appearance and the presence of a cuneus in the hemielytra. The rostrum is 4-segmented; tarsi 3-segmented; eyes very large; ocelli prominent; the species live under bark; small in size; probably occurs in New England.

p. 93. line 3 from bottom; for *3-* read **2- or 3-.**

p. 163. after line 4 from top insert; COLEOPTERA

Family Pselaphidæ.

p. 165. Legend of fig. 3; for *Pseudesobrachium* read **Pseudisobrachium.**

p. 172. line 8 from bottom; for *14* read **15.**

p. 213. line 1 from top; delete comma.

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